I wish to express my appreciation of the timely warnings given by the Weather Bureau both at this point and at Tampa during the recent West Indian hurricane. They were especially valuable at Tampa, as I have steamers operating from that point to Manatee River and Terra Cela Bay points, and the notice we had from the Weather Bureau prevented our leaving port on Saturday, the 12th. The observer at Tampa kept us fully advised as to the situation there, and his warnings to vessels not to leave port, in my judgment, prevented serious disasters. I think it is very fortunate for the agricultural and shipping interests of this State that we have such an efficient service of the Weather Bureau, and that the service is in the hands of such capable and accommodating officials.

The Tampa Evening Herald of September 15 comments editorially regarding the storm, and says, in part:

Too much credit for the saving effected can not be given to the Weather Bureau, and it is the intention of this article to direct public attention seriously toward one of the most valuable of the Government branches in this city.

The Weather Bureau observer at Jacksonville, Fla., reports that there is no doubt that a large amount of property and a number of lives were saved by the timely display of the storm warnings. During the displays ten vessels, the approximate value of which was one-quarter of a million dollars, remained in port at Jacksonville, and three vessels, valued at $135,000, at Fernandina. Sponge and fishing vessels, valued at nearly $200,000, and employing hundreds of men, remained in ports along the Florida coast, and the display of warnings undoubtedly saved many of these vessels and their crews. The observers at Tampa and Pensacola gave the widest possible distribution of the warnings, and state that they were, as usual, well heeded.

On September 16 a severe storm of small area advanced from the Atlantic Ocean and moved northward along the middle Atlantic coast, causing the loss of a number of lives and some destruction of crops and seaside property. Owing to the unusual character and course of this storm its indications did not result in a display of warnings until the morning of the 16th.

WARNING OF PACIFIC COAST GALES.

The severest storm of the year on the Pacific coast occurred on the night of March 9–10, 1904, when barometric pressure was below 29 inches on the Washington and Oregon coasts. The gales that attended this storm were severe from British Columbia to San Diego, Cal., and heavy rain fell in the coast districts and heavy snow in the mountain regions of the North Pacific States.

The Humboldt Standard, Eureka, Cal., of March 10, 1904, remarks as follows regarding the work of the Weather Bureau in connection with this storm:

One of the most violent storms that ever occurred on the coast of northern California was heralded yesterday morning by the display of southeast storm warnings at the local Weather Bureau station. The warnings were ordered up by District Forcaster McAdie twelve hours before the storm struck this city. All of the shipping in the bay having ample notice from the Weather Bureau, there was no damage to vessels, all shipping being securely tied up, with no vessels at anchor.

SPECIAL FORECASTS OF SNOW.

The following are some of the special snow warnings that, in addition to the regular forecasts, were issued for the benefit of transportation interests:

January 2, 1904: Snow will be heavy in the interior of New York and New England this afternoon and to-night, with high northeast shifting to northerly winds.

January 26, 1904: Heavy snow indicated for the interior of New York and New England during the next twenty-four hours, with high southerly shifting in New York to much colder northwest winds to-night.

April 15, 1904: Heavy snow and high easterly shifting to northerly winds indicated for the lower Lake region to-night.

SAVINGS BY COLD-WAVE AND FROST WARNINGS.

The following comments have been made regarding cold-wave and frost warnings:

[The Daily Picayune, New Orleans, La., November 19, 1903.]

Sugar planters have been warned by the Weather Bureau to prepare for temperatures as low as 25°, and reports received seem to indicate that they are acting in accordance with the warnings, and protecting the cane crop. A temperature of 25° so early in the season would damage the cane crop to the extent of millions of dollars unless protection is accomplished. Since sugar cane grows richer in sugar content with every day that it is allowed to grow, many planters cut their cane only as fast as they can manufacture sugar. In some seasons grinding is completed without a freeze, and the cane harvested at the close of the season gives much greater production than that harvested at the opening. With a feeling of certainty that he will be warned by the Weather Bureau of an approaching freeze in time to enable him to protect his crop, the planter lets his cane grow until warned by the United States Weather Service to protect his crop. The Weather Bureau has in the past saved millions of dollars to the sugar planter, for there has not been a freeze in recent years but what the lowest temperature which occurred has been announced in warnings issued twenty-four to thirty-six hours in advance of its occurrence.

[Savannah News of January 7.]

When the first intimation of the cold wave's approach was received at the Weather Bureau word was at once sent to florists and they were warned to have their fires up. These were immediately started, and when the wave reached here flowers were well protected.

[The San Francisco Call of January 20, 1904.]

Reports to-night from correspondents stationed throughout the orange districts of southern California are to the effect that the frost this morning did little damage to the citrus crop, which is now practically ready for market. Having received special warnings from the Weather Bureau, hundreds of ranchers resorted to smudging this morning, and thereby removed all danger to their crops.

[The San Francisco Chronicle of March 20, 1904.]

The farmer shares equally with the merchant the advantages of Weather Bureau warnings, and every year this service increases in efficiency and value. Many millions of dollars have already been saved by the fruit growers of California by timely warnings sent out, enabling citrus growers to protect their crops against frost, and the raisin, prune, and apricot growers to stack their trays of drying fruit before overtaken by rain.

[The Daily States, New Orleans, La., March 4, 1904.]

The warnings of the United States Weather Bureau were, as usual, timely and accurate, and they enabled the protection of berry crops and truck gardens, and have thus saved thousands of dollars to the farming interests.

[The Advertiser, Montgomery, Ala., March 5, 1904.]

The Weather Bureau's warning saved many thousand young cabbages and tomatoes which were exposed in cold frames, almost ready to transplant, and which would have been killed had warnings not been received. This item of benefit from the Bureau's warnings means $50,000 or more to the truckers of this section. Had these young plants been killed, an entire new crop of early sets would have had to be started, which would make the vegetables too late to command lucrative prices in the Northern markets. The warning, verified to the degree, was far enough in advance to be of great benefit.

RIVER AND FLOOD SERVICE.

PROGRESS IN WORK AGAINST ICE PACKS AND FLOODS.

Happily the floods of the year did not nearly approach in character and importance the great overflows of the spring of the year immediately preceding, with their destruction of over 100 human lives and property valued approximately at over $40,000,000. There were, nevertheless, severe floods at various times, and in the management of the work occasioned by them the river and flood service continued to demonstrate its usefulness and growing efficiency as a valuable branch of the Weather Bureau. That there has been a constant increase in the accuracy of its work is evidenced by the more specific and detailed character of the forecasts and warnings in localities where such refined work had heretofore been considered practically impossible. The service performed during the prevalence of the great winter ice gorges in the Susquehanna, Allegheny, and Ohio rivers, with their attendant floods, was especially noteworthy. These gorges were the greatest in the history of the localities, and that their great dangers were minimized is due in no small degree to the timely advices and warnings of the Weather Bureau.

There were minor floods during nearly every month of the year, but each was amply covered by timely warnings. These floods were not in any sense alarming or dangerous, but they nevertheless attained sufficient importance to endanger a large amount of property, which without the benefit of the Weather Bureau advices and warnings would have been totally lost.

As a matter of fact, considerable damage was done by these small floods, principally to growing crops which, of course, could not be protected, but the value of property saved by removal and otherwise was not far from $1,000,000.

ICE GORGES IN PENNSYLVANIA.

The great floods of the year were caused by the enormous ice gorges that formed in December in the Ohio and Susquehanna rivers, and continued during January in the Ohio and until late in March in the Susquehanna. The latter gorge was easily the greatest in our recorded history, the nearest approach to similar conditions having occurred in the same locality twenty-nine years before. From a short distance below Wilkesbarre, Pa., almost to the mouth of the river, a distance of 180 miles, there was practically a solid wall of ice, filling the river from bank to bank, and extending into the West Branch and Juniata rivers far up to their sources in the Alleghenies. In the North Branch of the Susquehanna, from Beach Haven to Sunbury, there was an unbroken mass of ice 40 miles in length and from 15 to 25 feet in height, much of it resting upon an entirely dry river bed. The floods caused by the gorges were very destructive. Towns, villages, farms, and railroad tracks were covered with masses of ice many feet in thickness, and bridges—some of them enormous steel structures—were moved from their piers. Below Harrisburg the destruction was even greater, although, owing to the wider channel, the ice was not piled so thick. Flood waters, carrying enormous masses of ice, were responsible for the major portion of the damage. At Middletown, Pa., the water reached a stage of 34.5 feet, the highest on record, and 5 feet higher than that of June 2, 1889, memorable as the period of the great Johnstown disaster. Some idea of the immensity of the gorges may be afforded by the statement that as late as May 20, 1904, ice in considerable quantities was seen in the Susquehanna River between Harrisburg and York Haven, Pa.

WARNINGS ON THE OHIO RIVER.

The Ohio River situation was equally unparalleled and almost equally grave, but very fortunately it was relieved without serious incident after a series of trying experiences and a prolonged period of apprehension. At Pittsburg the water reached a stage of 30 feet—8 feet above the danger line—and the official in charge of that station, with his corps of assistants, was compelled to remain on duty for forty-eight consecutive hours to receive reports from substations, issue warnings and advices, and furnish information to the public. Over 2000 telephone calls were received and answered during that time. The Cincinnati situation was another that required the exercise of the best judgment as well as unremitting attention, the critical time coming when the ice gorges began to move. Elaborate preparations had been made for this event and its passage found no one unprepared.

It can readily be seen that these situations were such as to require the exercise of the best possible judgment, combined with the utmost vigilance and caution. The officials in charge of the districts were constantly on duty, day and night, during the critical periods. Every effort was made to keep the people over the districts thoroughly alive to the extreme danger and gravity of the situation, and to the success of these efforts may be attributed the extremely gratifying fact that there is no record of the loss of even a single human life during a period of such imminent danger. The property loss was very heavy, but there were no losses that could have been averted. The people had been thoroughly prepared and every possible precaution was taken.

LOWER MISSISSIPPI PROBLEMS.

The lower Mississippi flood of the spring of 1904 was not remarkable. The usual warnings were issued one to two weeks in advance, and there were no abnormally high stages of water except at Memphis, where a stage of 39 feet was recorded, but 1.1 feet below the great high-water mark of the previous year. Some damage and inconvenience resulted, but the flood caused no great losses, and in a technical sense it afforded some extremely valuable contributions to our knowledge of the local régime of the Mississippi River.

The much-debated question as to the influence of the railroad embankment on Hopefield Point, opposite Memphis, in the apparent ponding of the waters of the Mississippi, has evidently been decided. The experiences of the last flood and that of the preceding year would seem to indicate that this water was not ponded, but that it was overflow water that had come through Reelfoot Lake district and was reentering the river.

It is also worthy of note that for the first time the St. Francis levee successfully withstood a severe flood.

EXTENSIONS OF THE RIVER AND FLOOD SERVICE.

Some extensions of the river and flood service have been made during the year. The Texas service was the first to be improved, the new service having begun promptly on July 1, 1903, with the addition of eleven reporting stations on the Sabine, Neches, Trinity, and Colorado rivers. Four days later the first flood warning was issued for the Trinity River. The north Pacific district has also been much improved, and the service will doubtless prove much more satisfactory in the future. Some lesser extensions have also been made, and the field of operations has been broadened during the year as much as the limited appropriations available would permit; but much yet remains to be done in order that the service may be made commensurate with the demands upon it. Very fortunately Congress, with a realization of the importance of the work, has appropriated a substantial increase for the river and flood service, and in a short time a considerable number of new stations will be in operation.

Arrangements have already been completed for the inauguration of a new service over the Kansas River watershed, the scene of the memorable floods of May, 1903.

LONG-RANGE FORECASTS.

It is hoped the time will come when it will be possible to forecast the weather for coming seasons—to specify in what respect the coming month or season will conform to or depart from the weather that is common to the month or season—but that time has not yet arrived, and the officials of the Weather Bureau have been informed that they will best serve the public interests when they teach the communities they serve the limitations of weather forecasting and warn them against imposition.

It is the opinion of the leading meteorologists of the world that the public interests are injured by the publication of so-called long-range weather forecasts, especially by such predictions as relate to severe storms, floods, droughts, and other atmospheric phenomena of a dangerous or damaging character. The publication of monthly forecasts has reached such proportions that it is deemed advisable to inform the public as to their harmful character. Some long-range forecasters may be honest, and may, in their ignorance, attach undue importance to storms that accidentally coincide in time of occurrence with certain relative positions of the planets, or with changes in the phases and position of the moon, or with periods of increase or decrease in sun spots or apparent variations in solar intensity. They may believe that they have discovered a physical law or a meteorological principle that has not been revealed to astronomers, meteorologists, or any other class of scientific investigators; but the publication of predictions that, by reason of their inaccuracy, are injurious to agricultural, commercial, and other industrial interests casts a serious doubt upon the honesty of their makers. Such publications bring the science of meteorology into disrepute, and can not, therefore, be made in response to a desire to advance

that science along useful lines; and they retard the work of the honest investigator, through whose efforts only can such gains be made in the fundamental knowledge of the causation of weather as will justify the making of forecasts for a month or season in advance.

VERIFICATION OF LONG-RANGE FORECASTS.

As the result of personal verification of the work of long-range weather forecasters, some of whom have so far gained the confidence of the rural press as to receive liberal compensation for their predictions, I am led to the conclusion that these forecasters do positive injury to the public at large.

Professors Garriott and Henry have personally verified much of the work of several of the most popular long-range forecasters, and much of what follows on this subject is extracted from a report recently rendered by Professor Garriott.

The proof of a forecast is in its verification. Measured by this standard, long-range weather forecasts have an experimental value only, a value that does not justify their employment in the actual work of forecasting for specified dates and places.

Meteorologists who have conceived theories for long-range forecasting, or who have tested theories advanced by others, have applied to the theories the test of facts that are presented by meteorological records, and the results have been negative. Men who issue fake forecasts have adopted an opposite method—they have carefully ignored and concealed facts and have depended upon advertisements of occasional successes that will inevitably occur in any system of chance.

The success of a long-range weather forecaster is usually measured by the extent to which he can impose upon the credulous and the ignorant. As a rule, it is impossible to subject the rambling and indefinite statements of the long-range weather forecasters to a verification. In the summer of 1903, however, one of these forecasters was induced to submit to the Weather Bureau some forecasts for verification. The forecasts consisted of an enumeration of certain dates around which "storms would cluster and develop great intensity." The periods, or dates, of maximum storm force, as given by the forecaster, appear in italics at the beginning of the six paragraphs next following, and a statement of the actual weather that occurred follows each date.

August 11, 1903: On this date there were no storms in any part of the United States and no extraordinary weather conditions were manifested at any point within the region of observation, except that a tropical disturbance of small diameter was apparently moving westward south of Jamaica, West Indies. As the forecast did not specify in what part of the Northern Hemisphere the storms would reach their maximum intensity, it can not be considered that the occurrence of this storm in any way verified the forecast.

August 24, 1903: On this date no evidence could be discovered of an increase in storm force, the usual stagnant summer conditions prevailing in all parts of the United States.

September 7, 1903: On this date the weather conditions were not unusual; there were no storms of marked energy in any part of the country. A disturbance covered the northern Rocky Mountain region and the upper Missouri Valley, but it moved northeastward and did not in any way affect the region to the eastward. There was nothing unusual in the disturbance above mentioned. A storm of considerable energy developed, however, in the vicinity of the Bahamas on September 10 and persisted in the vicinity of the Gulf region until the 15th. No mention was made of this disturbance in the forecast.

September 21, 1903: On this date likewise the usual weather conditions prevailed in all parts of the region of observation.

October 6, 1903: On this date a depression of considerable magnitude covered the eastern slope of the Rocky Mountains. It moved eastward and developed into a severe storm on the Atlantic coast on the 9th and 10th, three days after the date set by the forecaster.

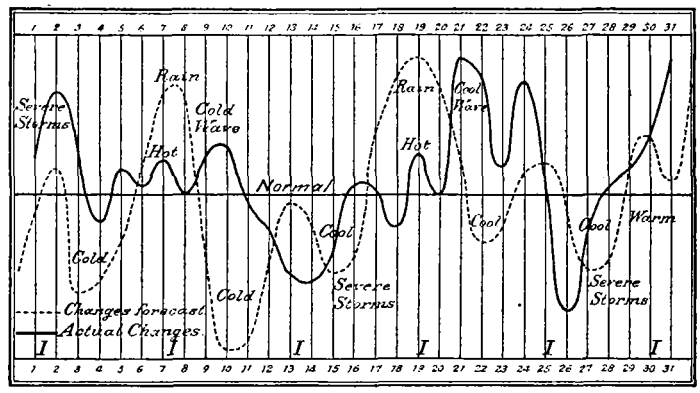
October 19, 1903: On this date the usual October weather prevailed in all parts of the United States. There was not the slightest evidence of increased storm energy on this date.

This is a plain statement of the weather conditions experienced on the dates when, according to the forecasts, the most severe storms of recent years were to occur. Let us quote one of the forecasts:

Clustering around September 7 and 21, October 5 and 20, will come some of the most severe storms of recent years. These will be so general all around the earth that I advise all to be on guard near the dates named. Storms miss 99 out of 100 places, but you will at least read of tornadoes, hurricanes, cloud-bursts, electrical storms, and seismic disturbances in nearly all sections where these sometimes occur.

Considerable time has already been devoted to an examination of forecasts of this character, and the results thus far show that the forecasters possess no knowledge that would justify them in the making of predictions.

The character of the work put forth by long-range forecasters is illustrated in the diagram below, which was made by one of those claiming the largest share of public attention. The central line is supposed to represent the normal temperature for March, 1904, and the dotted line indicates the changes forecast for that month. When the dotted line passes above the normal line warmer weather is indicated, and when it falls below the normal line colder weather is indicated. The original diagram, from which the illustration reproduced below was taken, does not show the amount of the expected temperature changes. In other words, it is conveniently left to the reader to determine the intensity of the hot wave or the cold wave scheduled for any given date. It is true that the crests of the warm waves and the cold waves are placed at different distances from the normal line; but the vital point, viz, the value of distance above and below the normal line, has been omitted.



MARCH, 1904, WEATHER CHART: The solid black wavy line, the word "normal," and the explanation in the lower left-hand corner were put upon the above chart by the Weather Bureau. All other matter, including the words "severe storms," "cold," "rain," "cold wave," "hot," "cool," etc., were copied from the original chart issued by this particular long-range forecaster. The dotted wavy line represents the temperatures predicted by him, the solid black wavy line the actual temperatures as recorded at St. Louis, Mo., a city on the ninetieth meridian.

The long-range forecaster says:

"In the above chart the letter I indicates the dates about which storm "waves, moving eastward, will reach meridian 90, which is about the "same as the general course of the Mississippi River. All weather events "move eastward across the continent and those marked on the chart are "expected to reach meridian 90 about the dates indicated. The straight, "trebble,[1] horizontal line, running through middle of chart, is the aver-"age temperature of March for many years past and the wave line is "temperature forecast for March, 1904, showing where temperature is "expected to go above or below normal, indicating how warm or how "cold it will be.

"*These weather charts are $1.50 a year; Weekly Bulletins $1.50 a year;*
"*'What and When to Plant and Sow,' $6.00 a year gives complete weather*
"*forecasts and advice; Probable effects of weather on Chicago and New York*
"*market prices of grain and cotton $3.00 a month.*"

[1] This has been reproduced as a single line. The use of three lines where but one is required appears to be simply another artifice of the long-range forecaster to avoid being specific

I have superposed upon the original drawing a solid black curved line showing the actual daily departure of the temperature from the normal at St. Louis, Mo., longitude 90° 12′ west from Greenwich. The scale used in entering the temperature departures was 16 degrees to the inch, or 1 degree to each sixteenth of an inch. I have also reproduced verbatim the explanation that accompanied the so-called chart, except that I have had the closing paragraph printed in *italics*. It will be noticed that the relatively warm periods in the diagram are placed about five days apart, viz, on the 2d, 8th, 13th, 19th, 25th, and 29th, and the cold periods nearly a week apart thus, 3d, 10th, 15th, 22d, and 27th. The solid black line shows the temperature changes that actually occurred during the month.

Three "severe storm" periods are given, viz, on the 1st and 2d, 16th to 18th, and 28th to 30th. There were no severe storms during the month. The highest winds experienced were on the 10th, 42 miles, from the southwest; 22d, 42 miles, from the southwest, and 24th, 50 miles, from the west. The two last-named occurred in connection with thunderstorms, and lasted but a short time. Not one of these high winds occurred on the dates assigned by the long-range forecaster.

To a long-range forecaster the occurrence of a thunderstorm or an electrical disturbance in some remote corner of the globe during one of his "storm periods" will fully justify his forecasts.

Forecasts of this character can be of no value to agricultural, commercial, or maritime interests. On the contrary, they are misleading, and, if given credence, are calculated to result in positive injury to property interests. As farmers, merchants, and mariners who keep pace with modern progress do not give credence to this class of forecasts, the natural conclusion is that a long-range forecaster who receives remuneration from the press for forecasts submitted is simply catering to a class of readers who are deficient in a knowledge of the present status of popular science and who have no occasion to compare the forecasts with weather conditions that actually occur on the dates specified.

There is another long-range weather forecaster who draws his support from the American public who does not depart in any essential manner from the methods employed by the one above referred to. His statements are based upon a consideration of the moon's path with reference to the ecliptic and the equator, the phases of the moon, disturbing causes due to movements and positions of the planets—in fact a conglomerate gathering together of all imaginary and obsolete notions regarding weather causes that are calculated to mystify credulous and uninformed people. He predicts the general character of a month with a consciousness that the forecast will be verified in at least some part of a great unspecified area. He then outlines "storm periods," with intervals of two or three days, which are covered by a margin that is claimed for verification purposes, and verifications are claimed if storms occur during the periods or in the intervals in any part of the United States and, at times, in the Northern Hemisphere. This system of forecasts and verifications admits of no failures. So much for his regular forecasts. Let us now examine some of his special, emphasized predictions.

In the early part of April, 1904, a tornado and severe storms were scheduled in various western papers, over the name of this forecaster, to appear "right after April 17." The storms failed to materialize in the United States during the period specified. Returns from remote parts of the Northern Hemisphere have not, however, been received, so it is possible that a justification of the forecast will be claimed. Aside from platitudes regarding average weather conditions that prevail in April, he announced that "one of the most decided, and perhaps violent, storm periods of the month extends from about the 25th to the 29th."

In the United States the period was a quiet one, and the disturbances that appeared (and one or more surely would appear within the area of the United States during the period specified) were not attended by "very general and violent storms, destructive hailstorms, and abnormal downpours of rain," which, according to the detailed forecast, should have been experienced.

His forecast statement for May, 1904, ends as follows: "The fifth storm period will be central on the 29th, and there will be violent disturbances. Watch the barometer, and if you have a trembling wife and children clinging to you for protection provide some place of safety in which to resort in case of danger."

Is it possible to soar to greater heights of nonsense? In what particular continent or country will the storm period be central on the 29th? The forecaster does not say. Is the entire population of the United States, or of the world, expected to dig cellars or caves of shelter in anticipation of a possible occurrence of a tornado whose path of destructive violence would not cover an area represented on a large map by a mark one-half inch in length made with a sharp pencil? Is it possible that a man who issues such totally unwarranted, sensational, and harmful forecasts is seriously considered by the intelligent portion of the American public? I regret to say that he and others of his kind have a considerable constituency.

CONCLUSIONS REGARDING LONG-RANGE FORECASTING.

A review of the foregoing remarks and opinions regarding the application of past and present astronomical and meteorological knowledge to the theory and practise of long-range weather forecasting leads to the following conclusions:

(1) That systems of long-range weather forecasting that depend upon planetary meteorology; moon phases, cycles, positions, or movements; stellar influences, or star divination; indications afforded by observations of animals, birds, and plants; and estimates based upon days, months, seasons, and years, have no legitimate bases.

(2) That meteorologists have made exhaustive examinations and comparisons for the purpose of associating the weather with the various phases and positions of the moon, in an earnest endeavor to make advances in the science along the line of practical forecasting, and have found that while the moon and, perhaps, the planets exert some influence upon atmospheric tides, the influence is too slight and obscure to justify a consideration of lunar and planetary effects in the actual work of weather forecasting.

(3) That the stars have no appreciable influence upon the weather.

(4) That animals, birds, and plants show by their condition the character of past weather, and by their actions the influence of present weather and the character of weather changes that may occur within a few hours.

(5) That the weather of days, months, seasons, and years affords no indication of future weather, further than showing present abnormal conditions that the future may adjust.

(6) That six and seven day weather periods are too ill-defined and irregular to be applicable to the actual work of forecasting.

(7) That advances in the period and accuracy of weather forecasts depend upon a more exact study and understanding of atmospheric pressure over great areas, and a determination of the influences, probably solar, that are responsible for normal and abnormal distributions of atmospheric pressure over the earth's surface.

(8) That meteorologists are not antagonistic to honest, well-directed efforts to solve the problem of long-range forecasting; that, on the contrary, they encourage all work in this field, and condemn only those who for notoriety or profit or through misdirected zeal and unwarranted assumptions bring the science of meteorology into disrepute.

(9) That meteorologists appreciate the importance to the

world at large of advances in the period of forecasting, and are inclined to believe that the twentieth century will mark the beginning of another period in meteorological science.

OBSERVATORY BUILDINGS.

Carrying out the policy of the Department, the Weather Bureau has continued to cooperate with the leading universities throughout the country, and at the present time the relations existing are more cordial and the work done more important than at any time in the history of the service. Several universities and colleges have donated ground for the erection of buildings, notably the Bradley Polytechnic Institute of Peoria, Ill., and the Epworth University of Oklahoma, Okla. Appreciation of the value of the work being done by the Weather Bureau has also been demonstrated by several other universities in placing at the disposal of the Bureau, without cost, office quarters in their buildings for recently established stations, among them being Brown University of Providence, R. I., and the University of Wisconsin, at Madison, Wis.

Buildings owned by the Weather Bureau.

Location.	Value of lot.	Value of buildings.	Total value.
Amarillo, Tex	$1,255.00	$6,503.00	$7,758.00
Atlantic City, N. J	(a)	6,000.00	6,000.00
Bismarck, N. Dak	(a)	10,000.00	10,000.00
Block Island, R. I	1,100.00	7,700.00	8,800.00
Cape Henry, Va	(a)	9,104.25	9,104.25
Devils Lake, N. Dak	2,300.00	8,000.00	10,300.00
Duluth, Minn	2,100.00	7,900.00	10,000.00
Hatteras, N. C	125.00	4,875.00	5,000.00
Havre, Mont	1,850.00	5,700.00	7,550.00
Jupiter, Fla	(a)	6,094.95	6,094.95
Key West, Fla	2,020.00	7,994.75	10,014.75
Kittyhawk, N. C	(a)	1,616.00	1,616.00
Modena, Utah	(a)	4,346.00	4,346.00
Mount Weather, Va.:			
Observatory building	2,000.00	18,000.00	20,000.00
Power house and balloon building	650.00	8,000.00	8,650.00
Stable		2,000.00	2,000.00
Mount Washington, N. H	(b)	300.00	300.00
Narragansett Pier, R. I	4,100.00	8,000.00	12,100.00
North Head, Wash	(a)	4,000.00	4,000.00
Point Reyes Light, Cal	(a)	3,000.00	3,000.00
Port Crescent, Wash	82.00	1,000.00	1,082.00
Sand Key, Fla	(a)	5,593.00	5,593.00
Sault Ste. Marie, Mich	(a)	3,000.00	3,000.00
Southeast Farallon, Cal	(a)	5,211.22	5,211.22
Tatoosh Island, Wash	(a)	5,000.00	5,000.00
Washington, D. C	25,000.00	150,000.00	175,000.00
Yellowstone Park, Wyo	(a)	11,500.00	11,500.00
Yuma, Ariz	(a)	1,500.00	1,500.00
Total	42,582.00	311,938.17	354,520.17

a Government reservation. b Leased.

Weather Bureau buildings in course of construction, and approximate cost of each.

Location.	Cost of lot.	Cost of buildings.	Total cost.
Columbia, S. C	$3,799.00	$9,170.00	$12,969.00
Peoria, Ill	54.00	7,915.00	7,969.00
Nantucket, Mass	1,236.50	3,968.00	5,204.50
Mount Weather, Va. (3 buildings):			
Absolute building	(a)	6,500.00	6,500.00
Variation building	(a)	8,000.00	8,000.00
Kite building	(a)	3,000.00	3,000.00
Total	5,089.50	38,553.00	43,642.50

a Government reservation.

The erection of buildings by the Weather Bureau not only saves the amount previously paid for rent of office quarters, but adds very much to the prestige of the service here and abroad. This prestige will be further increased upon the completion of the group of observatory buildings at Mount Weather, Va., at which place it is intended to conduct extensive experimental and research work. The present appropriation provides for the erection of not less than five buildings, but this number has proven inadequate to the growing demands from all sections of the country, and it is hoped that Congress will soon increase the appropriation sufficiently to provide for the erection of not less than ten buildings annually.

Rented buildings occupied wholly by the Weather Bureau.

Station.	Annual rent.	Other items included.
Cape May, N. J	$650.00	Heat, cleaner, light.
Durango, Colo	440.00	Heat, cleaner, water.
Flagstaff, Ariz	300.00	
Lewiston, Idaho	540.00	
Williston, N. Dak	450.00	Heat, cleaner, light, water.
Winnemucca, Nev	360.00	Heat, light, water.
Helena, Mont	504.00	Heat, water.
Santa Fe, N. Mex	360.00	
Charles City, Iowa	420.00	Heat, light, water.
Roswell, N. Mex	720.00	Heat, cleaner, light.

Stations at which observers' quarters are furnished by the Government separate from offices.

Station.	Annual rent.	
	Office.	Residence.
Havana, Cuba	(a)	$300.00
Honolulu, Hawaii	$480.00	540.00

a Public.

CLIMATE AND CROP DIVISION.

IMPROVEMENT OF ESTABLISHED LINES OF WORK.

The amount of funds allotted this division for this work during the year ending June 30, 1904 was the same as for the previous year. Therefore only those lines of work previously established have been pursued. The maintenance and improvement of established lines of work and the extension of the distribution of weather forecasts and special warnings as far as available means would permit have constituted the work of the year. The last-mentioned feature affords about the only item for especial remark in this report. Some of the older methods of distribution have in some instances been abandoned for the quicker, more effective, and less expensive means of dissemination by the telephone through rural telephone exchanges, the details of which are given elsewhere under the proper heading.

Action was taken during the latter part of the year to purchase a supply of thermometer supports of a new design, with a view of determining the advisability of their adoption for use at voluntary stations. These supports were not received in time to be given a test before the close of the fiscal year, but they are promised at an early date. It may be stated in this connection that there was a decided decrease in the breakage of thermometers at voluntary stations during the year, no doubt due in a great measure to a change in the method of mounting authorized in the previous year. From opinions expressed by some prominent section directors who have seen the new device, it is expected that the contemplated tests will lead to its adoption, and that a further decrease in the breakage of thermometers will result.

VOLUNTARY METEOROLOGICAL STATIONS.

Although nearly 300 voluntary stations were established during the year, the total number, 3367, but slightly exceeds the number in operation at the close of the previous year, nearly as many stations as were opened having been discontinued. No serious injury, however, has been sustained by the loss of a majority of the stations discontinued, as in but few instances were they located where it was important to have the records continued. Of the new stations opened a number have been located in the higher and less accessible places in the mountain districts in the semiarid States, with a view to meeting more fully the demands from irrigation engineers for rainfall data. Efforts have been continued to improve the instrumental equipment and the character of the exposure of instruments. More than 400 stations were inspected by section directors, and the inspection reports received show that, while most observers are efficient and painstaking in their work, there are but few stations that were not in some way benefited by the section director's visit.